DOCUMENT RESUME

ED 465 727 SP 040 873

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TITLE National Board Certification as Professional Development: A Study That Identifies a Framework and Findings of Teachers Learning To Manage Complexity, Uncertainty, and Community.
PUB DATE 2002-04-00
NOTE 30p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 1-5, 2002).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Elementary Secondary Education; *Faculty Development; Improvement; Science Teachers; *Teacher Certification; Teacher Competencies; Teaching Skills
IDENTIFIERS National Board for Professional Teaching Standards

ABSTRACT

The number of teachers certified by the National Board for Professional Teaching Standards has grown exponentially in recent years, with many teachers describing the experience as exceptional professional development. This study examined what teachers might learn from the assessment process. It compared and analyzed the recorded interview responses of two groups of Michigan science teachers (those who had just completed the assessment process and those who had not yet begun), hypothesizing that important differences would exist between the two groups that might provide insight into how the experience impacted them as learners. Examining the results with a grounded theory of analysis suggested that differences existed between the two groups. National Board certification acted as a mirror for candidates to gaze into their practice and gain affirmation of their way of teaching. The National Board certification process helped teachers learn how to address and manage more effectively three inherent issues of their work such as uncertainty of outcome, complexity of task, and professional isolation. The study identified a framework for understanding candidates experiences with National Board certification. It also provided lessons learned on improving the design to identify specific standards-based teacher learning outcomes in the future. Interview questions are appended. (Contains 59 references.) (SM)

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National Board Certification as Professional Development: A Study that Identifies a Framework and Findings of Teachers Learning to Manage Complexity, Uncertainty, and Community

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April 2, 2002
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Abstract: The number of teachers certified by the National Board for Professional Teaching Standards has been growing exponentially over the last eight years (NBPTS(a), 2002). Many of these teachers have described the experience as exceptional professional development. This paper will ascertain a more thorough understanding of what teachers may or may not be learning from the assessment process. By comparing and analyzing the recorded interview responses between two groups of Michigan science teachers (those who have just completed the assessment process and a parallel group ready to begin), it was hypothesized that important differences would exist between the two groups that may provide insight into how the experience impacted the candidates as learners. This cross sectional comparative qualitative study served as the pilot study for a prospective national investigation next year. Examining the results with a Grounded Theory of analysis suggests that interesting differences exit between the two groups. The findings include: 1) a framework for understanding candidates experiences with National Board certification, 2) candidate learning outcomes associated with the complexity of task, uncertainty of outcome, and isolation of practice were identified, and 3) lessons were learned on improving the design to identify specific standards based teacher learning outcomes in the future.

Introduction

Good research questions are said to "emerge as the perfect intersection between sociohistorical circumstances and one's own biography" (Boshier, 1994). The study discussed here on National Board Certification (NBC) is such a case. It grows out of the intersection of three separate strands of circumstances: 1) my experience becoming a National Board Certified Teacher (NBCT) in Adolescent and Young Adult Science (AYA Science), 2) the mounting evidence suggesting that the process of assessment for the National Board for Professional Teaching Standards (NBPTS) is a powerful teacher professional development, and 3) the desire to contribute to the growing body of work in this area.

Whether they pass or fail, teachers say they feel better about themselves as professionals and believe they are better practitioners because of their efforts. What are teachers learning (if anything) from National Board certification? In this analysis, teacher learning was examined in order to clarify, substantiate, and interpret teacher-learning outcomes from science teachers pursuing NBC in Michigan.

Literature Review

The following literature review will identify what we currently know and do not know about teacher learning from NBC. The review is structured around a conceptual framework that asks three questions: 1) How do we make meaning of *what* teachers are learning? 2) How do we understand *how* teachers are learning? 3) How does the current study *contribute* to what is already known? By addressing these questions, the analysis presented here can be positioned with in the context of current educational research.

The 'What are teachers learning?' question remains the least understood aspect of teacher learning from professional development. According to Wilson and Berne (1999), research in this area has yet to "identify, conceptualize, and assess" what teachers are

learning. There is a warranted expectation that candidates for NBC should be learning from the experience. Since its inception, NBPTS has maintained that the process of recognizing accomplished teachers should "provide opportunities for candidates to develop professionally" (ETS, 1999). In addition, NBC satisfies many of the parameters and requirements for a standards based professional development (Ingvarson, 1999; Little, 1993 & 1997; Ball & Cohen, 1995; Huberman 1993; Hargraeves 1995; Darling-Hammond & McLaughlin, 1996; Stein and Brown 1997; Sykes, 1999). Therefore, it is not surprising that the literature provides abundant evidence of specific instances of teachers benefiting from the assessment procedures. However, describing teachers as 'benefiting' from NBC lacks specificity and focus.

Much of our understanding of what teachers are learning is based upon self-reported data in the form of anecdotal testimonies, surveys, and qualitative studies. For example, numerous teachers have professed the benefits of NBC to their practice (Bailey& Helms, 2000; Gardiner, 2000; Jenkins, 2000; Chase, 1999; Benz, 1997; Haynes, 1995; Marriot, 2001; Roden, 1999; Wiebke, 2000). These teachers describe their experiences with NBC with such terms as, "enlightening" (Mahaley, 1999) or "revitalizing" (Areglado, 1999) to name just two. Overall, these reports describe teachers who "benefit" by becoming 'more reflective' in their practice. These accounts provide insights into the value of the NBC experience, but provide little detail about what candidates learn or how these adjectives translate into practice.

Surveys have been conducted that expand upon testimonial accounts and provide more extensive interpretations of what the population of National Board certified teachers (NBCTs) are learning from the assessments. For example, NBPTS issued two reports based upon survey data that provided a national profile of NBCTs and their feelings of "becoming a better teacher" from the NBC process (NBPTS, 2001a; NBPTS, 2001b). This type of information helps confirm the phenomenon of teacher learning from National Board certification, but still leaves questions open regarding these findings meaning or how they translate into teacher learning outcomes.

Research that looks not only at 'What are teachers learning?' but also at 'How are teachers learning?' tends to be more sophisticated and qualitative in nature. These studies provide valuable knowledge that confirms the findings in anecdotal and survey studies, but also reveals some possible connections between components of the certification process (i.e., other teachers and NBPTS materials) and teacher learning (Tracz, 1994 & 1995; Kowalski et al, 1997; Chittenden & Jones, 1997; Sato, 2000). These studies and others, provide compelling evidence that candidates learn from NBC by participating in extended professional communities (Burroughs et al, 2000; Manouchehehri, 2000; Rotberg et al, 1998). Such findings are strongly supported by research that describes teacher learning as a sociocultural or 'situated' phenomenon where learning results from the individual's participation in a professional discourse community (Lave & Wenger, 1991; Stein and Brown, 1996; Dewey, 1938). Studies that highlight the value of NBPTS materials (Kowalski et al, 1997; Rotberg et al, 1998), such as the standards documents and portfolio instructions, as sources of teacher learning are supported by the cognitive or acquisition theories of learning such as cognitive-developmental theory (Piaget, 1974), conceptual change (Strike & Posner, 1992), and cognitive flexibility theory (Spiro et al, 1988). These theories place the burden of learning upon the individual's development of knowledge and understanding.

What does the study presented here contribute to what is already known? With as much as has been learned about what teachers may or may not be learning as they participate in the National Board assessments, many more questions remain to be answered. For example, if the process of National Board Certification is used to recognized accomplished teaching, then to what extent does the assessment process contribute to a teacher becoming accomplished? Do all teacher candidates experience similar learning? Do some teachers learn more than others? Are learning outcomes different from different certificate areas? Most common in studies and reports of teacher learning from NBC are descriptions in less then specific detail such as "more reflective" or "more empowered". How can researchers make sense out of vague teacher reports of becoming a "more reflective practitioner" as examples of teacher learning?

Methodology

To investigate the question, "What are teachers learning from NBC?" a qualitative study was conducted that used a cross sectional pre-test and post-test design as means of comparing results (Campbell & Stanley, 1963). Each subject was identified from the Michigan Department of Education's records of grant awards to individuals seeking financial support for the costs of NBC. The grant applications and other materials were available for inspection. Form this information, science teacher candidates were identified, contacted, and invited to participate in the study. Subjects were compensated for their time with a $25 honorarium in the form of an online gift certificate to Amazon.com.

The subjects fell into two groups. Group 1 (post-treatment) consisted of science teachers who had completed all required assessment components. These components included the construction submission of a 6-entry portfolio[i] and the completion of all assessment center computer administered assessment tasks. Group 2 (pre-treatment) were science teachers who had successfully registered and paid for the NBC process. They may or may not have received their portfolio instructions and none had formally begun the process of constructing specific entries nor taken any assessment center exercises. I chose to investigate science teachers because of my experience with this particular certificate and my relatively strong understanding of science content.

The subjects from both Groups 1 and 2 were each interviewed once at their respective schools in Michigan during November and December of 2001. The aim of the interview protocol was to not only elicit teacher impressions of how the assessment process impacted their practice, but to also explore their ideas, thinking, and judgments concerning common issues in teaching and student learning, with a specific focus on science. The one-hour structured interview employed an identical stimulus-response protocol that asked subjects a series of background and introductory questions before delving into the questions targeted at teaching and learning (see Appendix I for protocol). The pedagogical questions fell into two categories: 1) questions requiring a self-report type of response (i.e. Can you identify an instance where students successfully reached your learning objective?) and 2) questions designed to probe the subjects' understanding of issues related to teaching and learning outside their own classroom experience. For example, pedagogical question number one asked candidates to evaluate a sample teacher's lesson and a student's written response. Subjects were asked to analyze the

artifacts for significance and decide whether the teacher was successful at bringing about learning in the student. For their answer, they needed to provide evidence for their decisions and insights. Other questions in this category included the analysis of a teaching dilemma, a school board proposal for a science technology laboratory, and a video clip of a teacher.

Once the interviews were completed, each recorded session was transcribed and analyzed. A grounded theory of analysis was used to develop thematic observations and conclusions regarding each candidate and the group to which they belonged (Merriam, 1995). It was hypothesized that the data would show clear qualitative distinctions between the responses from the two groups that could then be used to infer 'learning outcomes' from the certification process.

Results

The candidates for this study represent a fairly well diversified group. Table 1 provides a summary of average demographic information for each group that provides a profile of the types of teachers studied. Most significant here is the average years of teaching experience characteristic of each group. Group 1 teachers had on average 8 more years of experience then their Group 2 counterparts. There were 3 African Americans, 1 Asian American from India, and 6 European Americans. There were 3 males and 7 females. The average class size for the subjects was 26 students. The average grade level of the combined groups was 9^{th} with a range of 5^{th} -12^{th}. The average number of years experience was 17.2 years with a range of 8-35 years. Most subjects worked in urban settings and had 'average' students, though both rural and suburban and excellent and below average students were represented.

Table 1

Demographics	**Group 1** Teachers who completed the process (Post)	**Group 2** Teachers who were beginning the process (Pre)
Average Years Experience	21.2	13.2
Average level taught	9.7	8.5
Average Class size	22.8	28.2
Males	2	3
Females	1	4
Students	Above Average	Below average

Theories of Learning Science. In terms of their views and ideas regarding science education, there was a high degree of homogeneity. All the subjects in the study described science as something that must be actively learned through 'hands on' work. Students learn science 'by doing'. Science requires that students hold a test tube, measure a reagent, see, smell, and touch the object of a lesson. All subjects described the importance and use of laboratory experiments in their teaching as well as cooperative learning strategies. All but one teacher interviewed, expressed the belief that science must be 'fun' to be learned properly. Only one teacher used the phrase "Conceptual Change" to describe their views towards science education, but a few expressed a value

to know students ideas about a topic or objective at the beginning of a unit or lesson. Almost all teachers were quite knowledgeable about their content areas of expertise and felt comfortable and confident in analyzing the science components of the interview protocol (i.e., kinetic theory of matter and water cycle). I could support each candidate's explanation of a scientific concept as both accurate and clear.

Some of the questions from the interview inspired a high degree of commonality between both groups. Question #1 regarding the sample of student work and the teacher's assignment prompted nearly every subject to discuss the usefulness of rubrics as a means of clarifying communications between teacher and student. Nearly all subjects described the question "Where does the water come from?" in Question #2 on classroom dilemmas as a 'very weak'. Regarding the same question, nearly all subjects believed that the textbook has very little authority over knowledge.

Theories of Teaching Science. Except for these instances and their content understanding, views, and values concerning the teaching and learning of science, the subjects displayed a surprising diversity in teaching styles, epistemological perspectives, and ideas regarding the student's role in learning. Where a few teachers were inconsistent in their philosophies of teaching, most fell into the two established categories of either 'teacher-centered' or 'student-centered' pedagogy. Such a distinction made any concrete comparison of these teachers problematic. The identification of new skills related to planning, classroom management, or pedagogical strategies would not be practical when the subjects already demonstrate a diversity of practice both within and across groups. Where one class may be characterized by rows of students memorizing knowledge on worksheets, another class has groups conducting open investigations and constructing understanding. In a small study, such differences are difficult to accommodate when trying to identify teacher learning outcomes.

Diversity in values, beliefs, and approaches to teaching and learning can best be discussed within the teacher-centered and student-centered characterizations. For example, some expressed a view of practice that was highly teacher-centered where the teacher plays the traditional role of dispensing accurate information to students responsible for the learning or memorization process. These teachers often referred to students repeatedly during the interview in the third person "they", "them" or "the class". Recognition of individual students is rare if not completely absent. These teachers viewed knowledge as fixed and something to be 'known'. This classification of teacher was evenly dispersed between Groups 1 and 2.

Other teachers in this study were quite different. These subjects could be described as student-centered where students actively construct understanding of content. Teachers see themselves as guides who assist students' discovery and understanding of ideas. These teachers viewed knowledge as more contextual and community based. They were more willing to share authority with the students and tolerate (if not encourage) debate and dissent over meaning and interpretation of concepts. As one teacher states, "inconsistencies in textbooks can help drive learning". These subjects were more likely to describe individual students, the challenges in teaching them, and the importance of acknowledging individuality among learners.

These categorizations of teachers in this study are reinforced by the candidates responses to Question #5 on the interpretation of the video clip of a classroom teacher. The teacher in the videotape is a highly teacher-centered traditional classroom leader who

asks his students factual questions requiring exact and predetermined answers. Correct answers are rewarded and incorrect responses are dismissed. When the subjects are asked if they would want their child in this teacher's class, the responses strongly reflected the candidates own approach to teaching. For example, one teacher responded to the question by saying, "Yes. I do the same thing so I would certainly hope so!" The other typical response was, "No! That's not my idea of teaching and learning."

I take the same position as the NBPTS regarding the relationship between accomplished teaching and the traditional versus progressive labels. Namely, both approaches to teaching and learning can be effective in bringing about learning and each can fit within the standards of accomplished teaching (NBPTS, 2002). Moreover, the either/or distinction is convenient for making comparisons in a discussion, but ultimately fails to adequately describe the actual work of teachers in class. Teachers tend to have elements of each approach in their practice depending on the contextual circumstances of who are the learners, what is being learned, and how much time or other resources are available for a particular lesson or unit. Such an assumption opens the way for an analysis of how the process of National Board certification may influence teacher learning around central issues of complexity, uncertainty, and isolation without excluding or favoring any approach or style.

A Theoretical Framework

There is a tendency in discussions of NBC to group candidates into giant clumps that leave the reader with the illusion that there is a certain level of homogeneity to anyone who participates. To date, candidates either succeed in attaining certification or they do not. The question of learning from the process is much more complicated than a simple binary outcome. What did an individual learn from their experience of certification? How much of what an individual learn contribute to their passing or failing of the assessment? Some teachers may learn nothing and pass while others would learn a lot and fail. I became aware of this complexity when I noticed that some of the interviews from teachers who had yet gone through the process subjects were much richer and more interesting than interviews from those who had. I needed a way to conceptualize the candidates as they moved through the process of certification that would account for such observations. How could I identify teacher learning when all appearances suggested that my pre-Group were more knowledgeable than my post-Group? The following framework is presented as a way of making sense out of possible candidate learning experiences from NBC. The data of this study does not lend itself to making judgments regarding an individual's level of accomplishment with regards to the standards, it merely hints at its existence. This framework does not mean to suggest that I claim to judge candidates as accomplished or not in either group, rather, if such measurement tools were available to identify the level of accomplishment for each candidate prior to assessment, these different learning experiences may be identified.

Several observations led to the creation of this learning framework. I had been working under the assumption that NBC not only recognizes accomplished teachers, but that it also helps teachers to become accomplished in the Board's eyes. Answering the question, 'To what extent did the process contribute to these ends?' was one of my goals for the research. What I had not fully appreciated was the possibility that teachers might

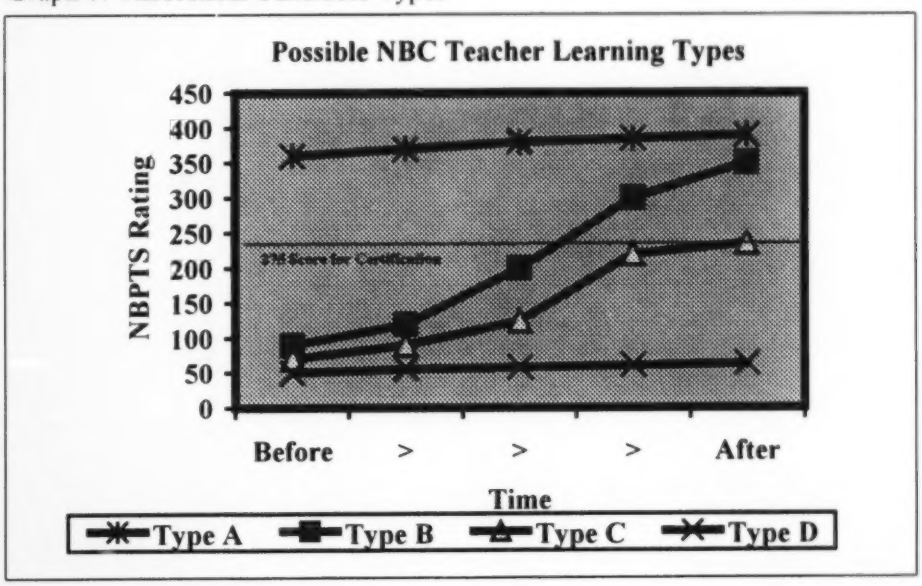
already be highly accomplished in terms of the Board standards. How would the certification process affect them? What could they learn that they did not already know? It became clear that the learning curves would appear much steeper for some than for others. Since I was investigating teacher learning from the certification process, it was necessary to accommodate the strong likelihood that the candidates were already differentiated on aspects of accomplished teaching and still find specific and meaningful differences between the groups from a thorough analysis of the data.

The resulting framework helps the researcher understand a particular candidate, the level of their practice in terms of the Board's standards before and after certification, and whether or not they were successful in attaining certification. With three variables and their negative (i.e., accomplished/not accomplished) for each candidate, there are 8 permutations four of which are quite important to this investigation. Table 2 identifies all eight possibilities and Graph 1 illustrates the four most readily observed candidate types. The following is very brief description of Types A, B, C, D, and the possible indications that could be used to identify them as 'accomplished' or 'not unaccomplished'.

Table 2 Candidate Types

Type	Before Certification	After Certification	Outcome
A	**Accomplished**	**Accomplished**	**Passed**
B	**Not Accomplished**	**Accomplished**	**Passed**
C	**Not Accomplished**	**Almost Accomplished**	**Failed**
D	**Not Accomplished**	**Not Accomplished**	**Failed**
E	Not Accomplished	Not Accomplished	Passed
F	Accomplished	Not Accomplished	Passed
G	Accomplished	Accomplished	Failed
H	Accomplished	Not Accomplished	Failed

Graph 1: Theoretical Candidate Types



Type A candidates are teachers who at the beginning of the assessment process already demonstrate a high degree of alignment between how they describe and analyze classroom practices and the standards of accomplished teaching established by the National Board. They expressed a desire to become less isolated within their professional community. They wanted to affirm their perceptions and knowledge regarding the complexity of task involved in teaching and learning. They recognized the uncertainty and managed it as a resource rather than an obstacle to achieving their goals with students. Through the process of certification, they usually achieved all their goals and found the valuable validation and affirmation that they were seeking.

Type B candidates are teachers who would likely show the steepest learning curve during the certification process. They began with a way of teaching that was not closely aligned with the National Board's standards of accomplished teaching, but finish identified as an accomplished teacher. These are the rare individuals who describe the process as 'life changing' and 'remarkable'. Their learning was so intensive; that it is nearly impossible at this juncture to even begin identifying what they learned or how it was learned. The possibilities are too great. They may be discovering a professional community for the first time. Their beliefs, values, and ideas of teaching as a straightforward and simple activity may change to that of teaching as a complex and uncertain profession. They may learn skills such as classroom management or cooperative learning. They may learn to share authority and tolerate less control over what happens in the learning process. It could be all or any combination of these possibilities or something entirely different. This would be an interesting group to study further.

Type C candidates were teachers who demonstrated a willingness to try new approaches or ideas in the classroom. Their practice may be quite rigidly set from a long and successful career, but they are flexible enough to entertain new approaches to their craft. These teachers learn from National Board certification, but do not qualify for the recognition of accomplished teacher. Reports from these candidates convey the message that "even though I failed to get certified, I learned a lot from the process." This group could potentially be one of the most numerous of the identified types. Much of what is said about Type B could also be applied to Type C as well.

Type D candidates were teachers whose practice was aligned only minimally at the beginning of the process and remain relatively unchanged throughout. These teachers tended to hold on to their ideas, values, and beliefs about teaching and learning with an iron fist. These teachers viewed their work as not complex and quite certain. For this type, teaching is like a science that is validated from their many years of experience. Isolation is not a problem, but a virtue of practice. They enjoy the autonomy and freedom isolation brings and express little desire to discuss pedagogical issues with colleagues or be involved in anything outside their immediate sphere of control. This type of candidate may express resentment, hostility, or suspicion regarding the National Board and the certification process. Though the Type D teacher may be quite effective at bringing about learning in students, their approach, ideas, values, and beliefs may not be in agreement with those of the National Board.

Discussion

This investigation attempts to gauge teacher learning from the National Board certification process. The assessment procedures are grounded in the National Board's definition of 'accomplished teaching' or what they have repeatedly stated: "what every accomplished teacher should know and be able to do." The Five Propositions of Accomplished Teaching[ii] are broad enough to include different styles or approaches to teaching so long as the values and meaning of the standards are addressed. Fundamental to this view of teaching are the acknowledgement of teaching as a complex and uncertain task occurring too frequently within the professional isolation of the classroom. As the Board states in its literature, the standards of accomplished teaching enumerates "the broad base for expertise in teaching, but conceals the complexities, uncertainties, and dilemmas of the work (NBPTS, 1991).

If traditional and progressive teachers can both be recognized as 'accomplished' through National Board certification, then prospective learning outcomes should not necessarily be thought of as teachers changing their practice from one style to the other, but rather, how teachers may alter their approach to manage the underlying issues present in all their work with students. From the data collected in this study and the supporting literature, it is my contention that teachers who learn from the National Board certification process may come away with enriched approaches to managing the complexity of their task, the uncertainty of outcomes with respect to those tasks, and the isolation of practice within a professional community.

Regardless of a teacher's style, one cannot be considered accomplished without acknowledging the existence and importance of these basic characteristics in the daily classroom grind. The evidence presented here supports the idea that the process of National Board certification helps promote teacher learning around these inherent characteristics of current practice. The analysis that follows will examine some qualitative differences between the before and after groups regarding the management of complexity, uncertainty, and professional isolation. These differences are illustrated with some specific examples. Observed differences are then traced to particular components of the assessment procedures as a possible explanation of how the certification process could result in the identified teacher learning outcomes. It is important to note that these differences were not exclusive to members of each group; rather, they indicate a possible tendency or increased probability that such differences might be present in a pre-test and post-test evaluation.

Complexity of Task

Teaching has long been described as a complex endeavor (Jackson, 1968; Lortie, 1975; Darling-Hammond, 1999). From content knowledge to pedagogy and from planning to assessment, teacher work has multiple requirements and infinite possibilities. If one then takes into account the learners in the teaching equation, with multiple learning styles, diverse backgrounds, and the different resources they bring to the classroom, teaching can become so complex as to be characterized as 'impossible work'; yet, it is performed everyday in millions of classrooms across the country. In order to avoid paralysis from too much complexity in their work, teachers develop strategies for dealing

with their responsibilities. In this analysis, I have chosen to look at how teachers evaluate successful teaching of an objective to students as an example of how the groups differ in their perceptions of complexity of task.

For example, Group 1 (Post) teachers were more likely to identify failure at either an individual or whole class level and accept the responsibility for the lack of achievement. Group 1 was more able to articulate and analyze their teaching decisions and pedagogical judgments regarding the classroom experience. Such an approach indicates an increased awareness of possibilities and interpretations that greatly increases the complexity of task. Instead of endorsing the 'one right way' of doing things, these teachers see a multitude of choices and variables that influence their success or failure in bringing about learning in students. Look at what Group 1 teacher Mrs. C. had to say about how why a particular lesson on molecular nomenclature and bonding did not result in satisfactory student understanding:

> Maybe I haven't done a good enough job of trying to make it significant for them. Maybe I see the big picture better then they see the big picture. I know something of why nitrates would be important. Even though I taught it to them in the nitrogen cycle, I think that a lot of them learned as much as they needed to learn to get through it, but they don't really have an appreciation for it. I think that they sometimes do the typical 'cram it all in your brain until the test' and then as soon as the test is over just let it blow out their ears and never comes back again. So maybe I can do a better job in the future of explaining why this is important. And maybe I need to discuss "maybe its not important". This is not the first year that this has not been so successful. I thought that the magnets would help, but maybe it's not worth doing.

Mrs. C's answer demonstrates a great awareness of complexity involved in why lessons may not result in satisfactory student understanding. The most significant aspect of this answer is her willingness to question the importance of these objectives at this time. As a biochemist, she knows the importance of this unit, but she also weighs it against other demands. She goes on to say, "Maybe this is not the hill I want to die on. Maybe I just want go light on it."

Another way that Group 1 demonstrates a greater appreciation for complexity of task is through their pedagogical decisions. Once again, when asked to explain a teaching and learning experience that was less then satisfactory, Group 1 teacher Mrs. M focused on the ways a teacher can determine student understanding:

> What I do, try to do, is if something doesn't seem to go real well,...then I try and go back and think of what can I do? What's something else I can add to it? What's another lesson I can do to try to hook in or bring in a few more kids understanding of that concept?

For Mrs. M, there is complexity in the strategies employed to bring about learning in students. If one way appears to be ineffective, what else can be done? As the teacher, what other approaches, techniques, or perspectives will 'bring in a few more kids understanding of that concept?"

In contrast, Group 2 (Pre) was more likely to describe a less than successful lesson as resulting from circumstances beyond their control. For example, Mrs. D's view of teaching is much more concrete. If students are unsuccessful in her class, it is not because of her teaching, but rather something else:

> If I get a student who has decided they are not going to work very hard, doesn't matter what I do, sometimes they don't put the time in. Then they go home and they don't study. And so I have had times where the class doesn't do well on a test, but I get frustrated because when it comes to that test, they didn't put the time in.

In this example, teaching and learning is viewed as a less complex endeavor. If students had simply worked harder, then they would have been successful. This is not to say that Ms. D's analysis may not be accurate, but rather to illustrate that she does not entertain the possibility that some of the responsibility of failure could fall on the teachers shoulder.

To demonstrate that the teachers enter the certification process at different levels of accomplishment, I offer Mrs. A's answer as a possible example of a 'Type A' candidate. For her example of a less then satisfactory teaching and learning experience, she describes a current example of a stoichiometry unit. She introduces the example by saying:

> My second year chemistry are not getting this thing. I won't say that they are failing right now, because I am not done with them yet. O.K.?

She goes on to provide a possible explanation for the lack of success by saying:

> I think the leap that I asked them to take was larger.... I think that what I am experiencing myself is sort of a discordance between the preparedness level of the really sharp kids...and their not being asked to make these kinds of leaps before.

In her explanation of why the kids were not successful at 'making the leap' required for these lessons, she says:

> I can't answer that question cause it's so huge. Its like, yeah, it's the parent's. It's the schools. Yeah, it's where they live. It's how they were raised. Its how we teach. It's the whole thing. It's everything. It's the stress level in their families in addition to the parenting skills and .... I mean it's a big answer.

Ms. A is demonstrates a comprehensive awareness of complexity in her task. She seems to be fighting off the paralysis that can come from seeing too much. She is aware of her possible misjudgment of student preparedness to take on stoichiometry, but she also describes the greater array of possible influences outside her room. Ms. A provides an example that illustrates the observation that some teachers have great awareness of the complexities of teaching before they begin certification. It would be interesting to see how her answers might change in a post-certification interview.

Recognizing complexity and identifying its role in the process of education is arguably the most highly valued knowledge for National Board certification candidates. It is clear how such learning outcomes could be traced back to the prescribed activities in the assessment procedures. Teachers may acquire this knowledge of complexity because of portfolio construction demands. If teachers are not aware of the complex nature of what they do, there is no way to put together a satisfactory analysis of their work for the portfolio. It is simply not satisfactory to respond to a prompt asking a candidate to discuss an example of student work by stating, "The student learned." Candidates need to delve into the question and embrace more than the obvious such as "What did the student learn and to what extent did they learn it? What is the evidence to support the conclusion of learning? Where is their understanding strong and where is it weak with regards to the stated objectives?"

Many of the prompts from the portfolio require teachers to spend five to twelve typed double spaced pages to discuss an artifact from their class such as an example of student work or a twenty-minute video clip (NBPTS(b), 2002). If a teacher is blind to the potential complexities of their practice, they cannot adequately respond to the assessment questions. The prompts force them to think hard and possibly seek ideas from colleagues regarding areas of hidden complexity. Not being able to recognize the multiple shades or levels of student understanding with regards to a specified learning objective demonstrates a less then complex view of teaching and therefore not congruent with National Board's standards of accomplished teaching. If candidates are to attain certification, they need to develop or cultivate their ideas of teaching as a complex task.

Uncertainty

Uncertainty of outcome in education is an issue that plays a role in the daily life of teachers (Floden, 1993, Dewey, 1980; McDonald, 1992; Seixas, 1997). A teacher defines uncertainty in this context as not knowing for sure what, if any, learning will occur in response to specific actions, decisions, or comments. At the heart of uncertainty in teaching and learning is the qualification of teaching as the practice of 'human improvement' (McDonald, 1992, Floden, 1993). NBPTS accepts uncertainty as a reality of the classroom experience. There is uncertainty of outcome, uncertainty of student response, unexpected tangents to classroom discussions, unanticipated ideas from students, and unintended consequences from particular teaching decisions. How a teacher deals with uncertainty in the classroom is important to whether or not they are accomplished according to the National Board standards. It is expected that even the most accomplished teachers would be able to recognize a surprising student learning outcome or unforeseen question not as an obstacle to teaching and learning, but as an opportunity to enrich teaching and learning. The so-called 'teachable moments' as they are often referred to arise out of the unexpected consequences from teacher decisions and actions. Teachers who are sensitive and receptive to these moments tend to accept a level of uncertainty in their classrooms as a necessity rather than an as a threat to their authority or control over students.

However, not all teachers acknowledge uncertainty to the same degree. In this study, there were identified differences in how teachers manage to reduce uncertainty. Some of the subjects interviewed for example, described strategies for reducing it to

make their work more effective. For this discussion, examples from one of the questions dealing with how teachers assess student understanding of a particular learning objective will illustrate this difference in these strategies.

For example, Group 2 (Pre) was more inclined to determine success in class by seeing 'lights going on in students', where teachers in Group 1 (Post) were more inclined to use a written form of feedback to see if the students 'really got it'. Group 1's strategy of data collecting, reduces the uncertainty of outcomes from teaching and give the teacher a more substantiated idea of how each student understands or does not understand a given objective. Here are some samples of how Group 2 teachers assessed student learning. In regards to lessons regarding food chains, Mrs. J says,

> Kids just pull it out of the air, 'Oh, O.K. Food chains. I get it.' Cause we were seeing a video clip and we were discussing it as we went along. Phytoplankton and krill. "Oh so they, the bigger things, eat that and then the next bigger things eat that" And I could just see more lights going on about food chains.

Another teacher from Group 2, Mr. D, describes his experience with balancing equations by saying:

> Well one student said, "oh its like math. This is the distributive process." And I said, "You're right." Then the light went on and a bunch of other kids said, "Oh, that's how it works."

In contrast, Group 1 teachers were more likely to describe assessment techniques that relied more heavily on written evidence. This is not to say that they did not gather data from classroom discussion; but rather, that to attain a greater degree of certainty regarding student understanding in relation to the desired objective, Group 1 teachers tended to gather a greater variety of data. For example, Mrs. M describes her method as follows:

> Afterward, I collect their worksheets and I read through them. And it is really interesting. That is the good thing for me to do because I can go through and see if they are truly understanding what the concept is.

Mrs. M describes a similar approach:

> I get the feedback sheet from my students, whether it's a lab sheet or some kind of investigation sheet or maybe its just I have them write paragraphs before on what they think about a concept.

Another Group 1 teacher, Mr. J., uses a similar strategy, but incorporates technology to facilitate his data collection. Mr. J. says,

> I went on a field trip to an exercise physiologist in my biomedical science class. What a great effort. The kids knew that they had to go to the (web)site in the evening and answer all the questions about that visit. So it is more reflective.

> What did you get out of it? What did you like most? What did he say that you knew? What did he say that you learned that's different? It was about exercise physiology. With those reflective things, I can begin to see, I try to see things, "oh, that kid really understood that well like that". If I don't see things in their reflective pieces, I can say, "well nobody mentioned this. What do you think about that?" I can come back on the second day....This way I can find out what everybody thinks, not just one kid. And they will 'talk' more on line than they will when they are with their peers. I am trying to get, "O.K. you all like this, but what did you think of this?" We talked about this. And then you can generate discussion.

This evidence suggests that teachers acquire a greater expertise at managing uncertainty in the classroom. Once again, this learning could be traced back to the portfolio construction. Specific to this example, are the repeated instructions of the entry prompts for 'consistent and convincing evidence' of teacher judgments and analysis (NBPTS, 2002b). If teachers are to attain certification, they must back up their assessments of student learning with more than just 'lights going on'. They need to present documented proof that their analysis is consistent with what students experience. These requirements cause teachers to acknowledge a complexity to their assessment procedures they may not have been aware of before and manage them in a way that makes sense to a larger community.

Isolation

Teacher isolation is a well-established problem in the academic literature (Jackson, 1968; Lortie, 1975). Effective professional development is believed to be reliant upon disrupting this isolation and increasing professional collaboration and community (Bondy, 1997; Cobb, 1999; Connolly, 2000; Mycue, 2001; Rogers, 1999; Weld, 1998). In the interview, there is a question about a school board initiative to develop either a new science facility or a computer science facility. Though members of both groups rejected the proposed binary and expressed a desire to create a third option that included aspects of both the choices, there was a distinct difference in how members from each group would ultimately make the recommendation.

Group 1 (Post) teachers were more likely to express this point of view but also address the need to include a community voice in the decision, not just their own. They often used the word "we' to analyze the needs for the school or students. Their community could include the rest of the department or parents and community leaders. They sensed the magnitude of the decision and recognized the need to share the responsibility of with others. Group 1 teachers saw themselves as less isolated and more integrated into the whole of the community. The way teachers evaluated the technology versus traditional science option indicates an awareness of professional community and issues that go beyond one's own classroom. For example, Mr. S described his thinking as follows:

> How well does the community and the parents trust you and the students to use the computers properly and not be at unapproved sites. How well does the district

> have its own computer specialist that can put up proper firewalls that students can't get around to avoid these undesired sites? How much support will there be from parents and others for broken materials? What if a student gets angry and nocks a computer down. Will they pay for it? Well it's a lot cheaper to pay for a few test tubes than it is for a new monitor. Those are things I would need know about to make my final decision. What's the support for?

Mr. S's perspective not only includes what might be best for the students, but what would work best for the entire community. Another teacher from Group 1, Mrs. I., put her thoughts in these words:

> I would need someone assisting me in that (decision). I myself cannot make a decision on that. I need help cause I am not an expert in all fields. Because it is for all science branches.

Mrs. I. accepts her lack of expertise and is thinking of the needs of her colleagues. She wants what is best for all, not just herself.

Group 2 teachers were more likely to make their decision based upon their own ideas, needs, and desires. They almost exclusively discussed the decision in terms of "I" and only rarely mentioned their fellow colleagues. However, in another part of the interview, Group 2 teachers were more likely to express a desire to become less isolated. For example, Mrs. J. hopes the experience with NBC will correct her situation. She says:

> The biggest reason I want to go through it is that there is no credible input into my professional life. My principal comes in once every three years now and says 'Great job!' and walks out the door. I invite people in. I invite parents. Nobody really knows what is going on in here. They really don't. They trust me, which is a nice thing. I think I am very trust worthy. I have a track record of not abusing that trust. But there is really no way of improving practice. I could take a million classes, here and there, but you don't get feedback specifically. I think this will give me feedback

Another Group 2 teacher put it this way:

> I am very excited about networking and meeting other people who have the same ideas and approaches that I do. They want to be the best teacher they can be, they are willing to work hard. They want to look at what they do and improve upon it, analyze, reflect, improve their lessons, and continue to work for higher thinking goals.

Learning to view teacher work as part of a larger community is not an unexpected outcome from NBC. The National Board places a high value on participating in a professional community as part of the responsibilities of an accomplished teacher. As part of their Five Core Propositions of Accomplished Teaching, #5 states that 'teachers are members of professional communities." Therefore, teachers who are less isolated and more integrated into the larger community around them, would be closer to these

standards of accomplished teaching than teachers who saw themselves as alone. If a teacher wishes to improve their chances at attaining National Board certification, they must demonstrate their commitment and involvement with parents, colleagues, administrators, and community leaders (NBPTS, 2002b). As teachers learn to participate in a discourse about teaching and learning beyond their classroom, they gain more situated knowledge regarding their work with students from the surrounding neighborhoods.

Problems with Study

The observations and qualitative conclusions drawn from this work are made with a high degree of hesitancy due to several important design problems. First and foremost, the small sample size of only 5 subjects per group, makes any comparisons tentative at best. The observed and identified differences may easily be explained by random variation. A much larger pool of subjects is needed to address this issue. A second related problem was the wide range of grades in which subjects taught. Where I would prefer to conduct an analysis of only high school science teachers or middle school science teachers, due to the small pool of candidates in MI, I was forced to combine both groups for the comparisons. At times, I felt that the grade level at which teachers worked affected their interpretation of the interview questions especially the artifact and video clip questions.

The purpose of the study was to field test measurement instruments for a larger study to be conducted next year. On the advice of my advisor, the study should be an opportunity to "play around" with ideas and design techniques to see what works best for the questions that are asked. In response, I developed a protocol that in many instances was quite open for interpretation by the subjects. Rather than ask them to address the issue of 'uncertainty' directly, I provided them with a situation to see if they recognized uncertainty and if so to what extent. Such an approach, led to a broad spectrum of answers that did not lend themselves to a pre-test and post-test group comparisons.

Finally, the timing of the interviews was less than ideal. I had originally intended to conduct all interviews before the end of November when Group 1 members would be finding out from the National Board whether or not they attained certification. Unfortunately, due to some problems beyond my control, this could not be done. Therefore, all candidates in Group 1 knew their status with the Board. Of the five subjects interviewed, two passed and three did not pass. Those who passed were quite happy and those who failed were, not surprisingly, upset. How much this clouded or influenced their answers, I do not know. But in the future, it would be best to collect data before candidates know their status.

Conclusion

Initially, I had hypothesized that the process of National Board certification might help change a teacher's particular beliefs and values about teaching (i.e., from traditional to progressive), I know believe this to be inaccurate. Rather, National Board certification acted as a mirror for candidates to gaze into their practice and gain a much desired affirmation of their way of teaching. The centered teacher saw their practice as valid in

the framework of the standards. The student-centered teacher saw their practice as valid in the framework of the standards. Few, if any, were moved by the experience to actually change their approach or their beliefs about practice as a result of their work with the assessment procedures. Rather, certain details of their practice may have been 'tweaked' or 'adjusted' to be more inline with the standards of accomplished teaching. However, literature that describes the 'benefits' of NBC appears to stem from more then just tweaks or adjustments. The process may help teachers position their values, beliefs and approaches to practice within a complex, uncertain, and less isolated context. Teachers who learn to acknowledge and manage these conditions of work may express this outcome as becoming more 'reflective' or 'empowered' in what they do. Examining the NBPTS through a theoretical lens based upon identified and described central issues of practice suggests a means by which the hinted at power and effectiveness of the National Board experience for the candidates may be revealed and explained.

NBPTS is a growing and potentially effective reform effort. Its impact on the educational system from teacher education to student achievement could be quite great. Money (both private and public funds) is being spent that supports a particular conceptualization of accomplished teaching. Claims both for and against the NBPTS are being made and lines are being drawn. Yet, what we know about the teachers, their experiences, and their effectiveness at bringing about learning in their students remains relatively unknown. NBPTS has been certifying teachers for less than a decade and research on these teachers has only just begun.

The study discussed here identifies a framework for thinking about teacher learning experiences from National Board certification. By describing different potential categories of teacher experiences and identifying the most common or important groupings, future planning, research, and evaluation could be enriched by this framework. If this framework proves useful in research on teacher learning from National Board certification, it could find additional applications in Teacher Education Programs and other professional development initiatives.

The process of National Board certification seems to help teachers learn how to address and manage more effectively three inherent issues of their work: 1) uncertainty of outcome, 2) complexity of task, and 3) professional isolation. The problems of uncertainty, complexity, and isolation serve as potential barriers to teacher effectiveness at bringing about learning in students. By identifying a specific professional development experience that may help teachers recognize, utilize, and attend to these conditions has the potential of offering a valuable resource to improving the quality of teaching in classrooms all over the country.

Acknowledgements
I could not have done this study without the support of my wife, Doreen. Only other Ph. D. candidates with families could truly appreciate the awe and love I feel for her. I would like to thank the AERA reviewers who approved this presentation and saw potential value in my ideas and the dissenters who raised important issues for me to address. Special thanks go to Gary Sykes, Susan Melnick, and Mary Kennedy who provided valuable guidance and direction throughout this work. Thanks to Joseph Flynn, Dan Copeland and Cindy Kendall for their camaraderie and support when I had none. Finally, I would like to thank each and every teacher who participated in this study. Their ideas about and dedication to teaching are truly inspiring.

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Endnotes

[i] The 'class' of 2001 represented the last group to use the 6-entry portfolio. The 2002 group constructed an updated 4-entry portfolio.

[ii] The five core propositions as stated on the website of the NBPTS are as follows:

1) Teachers are committed to students and their learning.
2) Teachers know the subjects they teach and how to teach those subjects to students.
3) Teachers are responsible for managing and monitoring student learning.
4) Teachers think systematically about their practice and learn from experience.
5) Teachers are members of learning communities.

From: http://www.nbpts.org/standards/five_core.html

[iii] Question was adapted from Lampert's discussion of teaching dilemmas (Lampert, 1985).

[iv] Question was adapted from Kennedy's research on change in teacher knowledge (Kennedy et al, 1993).

Appendix I

Interview Protocol for National Board Certification Assessment Research
Principle Investigator: David Lustick

Fall, 2001 Start Time:_____ End Time_____

This is an interview with (First name last letter) a science teacher in Michigan pursuing National Board certification. The date is _____ and the time is _____.

Introduction Questions:

1) **How long have you been teaching?**
2) **What subjects and grade levels do you teach?**
3) **How would you generally describe your students?**
4) **What is your average class size?**
5) **How did you find out about NBPTS?**

I. Example of teaching and learning: See Artifact #1 & #2
Please examine the following artifacts. This is a lesson from the end of a two week science unit on Kinetic theory of matter. The teacher distributed this advertisement and asked students to write an essay that interprets what this ad from a kinetic theory point of view.
Here is what one student wrote in response. Please read it.

Teacher's lesson: "Imagine something that looks so fluid yet feels so solid"

Student Response: (original has teacher's markings)

The phrase used has much to do with chemistry, and has many little details to make the car sound so unique. First of all, the author of the quote wants the viewer to imagine the car as a liquid. According to the kinetic theory of a liquid; the molecules move faster than in a solid, but not as fast as gas. They are always in constant motion, relating to the car. The attraction between the liquids is greater in a liquid than in a gas. This attraction is known as intermolecular force. Since the bonds are weaker than solids, liquids, can take up any shape. If the car is liquid, the wind can go around the it depending on how the liquid shapes itself. Liquids have a very low compressibility giving the viewer security as well. In the event of an accident even thought the car moves so fast. Fluidity is a property that a liquid contains. If something flows, it is often seen as smooth and clean. Liquids, by having strong bonds, but relatively high molecular movement, move over surfaces like a snake in constant motion. This same idea is thought about the Mercury Sable.

When the author states "yet feels so solid", he is trying to give the viewer comfort since the car looks like it moves so quickly. This relates to the kinetic theory of solids. The intermolecular bonds between the molecules are much greater than in liquids or

gases. The molecules have much less kinetic energy and are found extremely close together. Since the car feels so solid, it gives the driver a sense control of what he is doing. Also, a solid has no compressibility and is extremely dense, giving the reader security in the event of a crash. The car will be able to withstand high amounts of impact. If something is solid, it has definite shape to it, therefore luxury. The car flows like a liquid, but is safe and comfortable at the same time.

Questions:

1) Is there any additional information you need regarding these artifacts, before responding to the questions?
2) As interactions between a student and teacher, what stands out as significant?

Prompt as necessary:

What do you mean by that? Please explain.

What do you see here that makes you say that? Note any inconsistencies in answers (i.e., grade given and student learning)

II. Teacher reactions to classroom dilemma[iii]:

During a science unit on the "The Cycle of Water", a teacher is faced with a situation. One of the questions from a workbook exercise asks, "Where does the water come from?" The answer provided by the teacher's guide is "clouds". One student, Linda, took exception to the answer. She approached the teacher and insisted that the answer to the question was "*the ocean*". The teacher asked the student, "Please explain to me why you think that is the answer." Linda said, "The clouds pick the water up. I don't know how, but it puts the water from the ocean back in the clouds." The teacher decided that the student did "know" what she was supposed to learn from the lesson and gave Linda credit for a correct answer.

Upon returning to her group, Linda told her classmates that she wasn't wrong about the question. The other students began arguing with her because the teacher and the answer key both indicated that the correct answer was "the clouds". The students then asked the teacher, "Who is right?"

If prompts are necessary, place the presented dilemma in the context of a hypothetical teacher interviewed earlier. For example, "a teacher last week pointed out that there was an issue of textbook authority in the example. What do you think about that?"

III. Success and Failure[iv]

a) Can you describe a recent instance from your classroom when students successfully achieved your learning objectives? Please elaborate.

b) To what do you attribute the success of this lesson?

(If more prompting is necessary, put question in a 'devil's advocate' structure such as "Would you say then that you were more enthusiastic for this lesson?")

(If subject is still unsure or unclear, show them the list and ask them to identify the most important reason for success:

1. Student's home background
2. Student's intellectual ability
3. Student's enthusiasm or perseverance
4. Teacher's attention to the unique interests and abilities of students
5. Teacher's use of effective methods of teaching
6. Teacher's enthusiasm or perseverance.

(Discuss why you made the choice.)

c) Can you describe a recent instance from your classroom when students failed to achieve your learning objectives? Please elaborate.

d) To what do you attribute the failure of this lesson?

(If more prompting is necessary, put question in a 'devil's advocate' structure such as "Would you say then that you were less enthusiastic for this lesson?")

(If subject is still unsure or unclear, show them the list and ask them to identify the most important reason for success:

1. Student's home background
2. Student's intellectual ability
3. Student's enthusiasm or perseverance
4. Teacher's attention to the unique interests and abilities of students
5. Teacher's use of effective methods of teaching
6. Teacher's enthusiasm or perseverance

Discuss why you made the choice.)

(Compare the subjects' answers and look for inconsistencies. If present, ask them to explain; i.e., if teacher attribute's success to her enthusiasm but failure to her lack of concern for student needs)

IV. Computers or Laboratory?

Your district is considering how to make an investment in the support of science education in your school. Here are the two options they are considering:

Option 1

Your district is considering the purchase of a comprehensive new computer software package along with the necessary hardware to support the teaching and learning of _____ in your school.

The software program is divided into two parts: a student component and a teacher component. The student component includes hundreds of digitized video clips of relevant scientific phenomenon, student exercises, a glossary of all required terms, hundreds of illustrations, photographs, and important graphics, brief content descriptions, virtual laboratory experiments that allow students to control the variables and observe results instantly, and dozens of quick, easy, and fun "things to do in science". The teacher component has everything present in the student version plus lesson plans, pre-designed tests, a data bank of multiple choice questions for teacher designed assessments, laboratory experiments with answer keys and more in depth content analysis and recommended teaching strategies. The hardware promised is top of the line, the most reliable, and fasted systems available. The speed, performance, access, and manipulation of information is most impressive. Your classroom will be equipped with a class set of computers, an array of additional useful programs, printers, web access, and overhead projectors for use with the computers. You will also be receiving extensive professional development on how to manage and maximize the use of this new technology. Finally, the technology department has provided assurances for on demand technical assistance whenever necessary. The investment in technology would be in lieu of a new science textbook, science laboratory, and supporting materials.

Option 2

Your district is considering the purchase of a fully equipped state-of-the-art science laboratory facility to support the teaching and learning of _____ in your school.

The district would provide the funding for the construction of a fully equipped state of the art science laboratory complete with water, gas, and electricity at 12 student stations. In addition, the laboratory would have a gas hood, safety apparatus, green house, open spaces, a white board, chair desks, and all the reagents, apparatus, and materials you deem necessary. The district will also provide professional development on how to best use the science resources. In addition, a new science textbook and supporting materials will be issued for your class. The textbook series has includes hundreds of photographs of relevant scientific phenomenon, student exercises, a glossary of all required terms, hundreds of illustrations and important graphics, content descriptions and review questions, laboratory experiments, and dozens of quick, easy, and fun "things to do in science". The teacher component has everything present in the student version plus lesson plans, a variety of pre-designed tests, laboratory experiments with answer keys and more in depth content analysis and recommended teaching

strategies. Investment in the science laboratory would be in lieu of new technology, software, and supportive materials.

You have been approached by your principle to provide your ideas regarding the decision that the School Board needs to make.

1. From your point of view, what are the advantages and disadvantages of the district opting for computers or laboratory?
2. What else would you need to know in order to make your final recommendation?
3. In light of your analysis, which option would you favor and why?

V. Examining another Teacher: A 3 minute video clip

The following video tape contains a presentation by a teacher. Please watch carefully and then I will ask you some questions. (Video clip will be viewed on a 'view cam' with picture and sound.)
After viewing, ask each question:

1) Would you want your child to be in this teacher's class? Why or why not?
2) How would you describe this teacher and his practice to a fellow colleague?
3) What aspect(s) of your work do you think you have in common with this gentleman?
4) How is your practice different than his?

VI. What do you anticipate will be NBPTS's greatest effect upon you and your practice?